Influence of Sedimentary and Seagrass Microbial Communities on Shallow Water Benthic Optical Properties

Fred Dobbs
Department of Ocean, Earth and Atmospheric Sciences
Old Dominion University
Norfolk, VA 23529
phone:(757)-683-5329 fax:(757)-683-5303 email: fdobbs@odu.edu
Award #: N000149710018

LONG-TERM GOAL

My long-term goal is to contribute to the CoBOP project's development of a radiative-transfer model for selected sub-littoral zone environments. My particular interests concern the optical effects of microorganisms at the sediment-water interface and on seagrass blades.

SCIENTIFIC OBJECTIVES

Determine the biomass and composition of sedimentary microorganisms at field sites nearby Lee Stocking Island, Bahamas, and in Monterey Bay, California.

When possible, assess seasonal and interannual variations in these microbial communities.

Similarly, determine the biomass, composition, and temporal variation (seasonal and interannual) of microorganisms associated with seagrass blades at Lee Stocking Island (turtle grass, *Thalassia testudinum*) and in Monterey Bay (eel grass, *Zostera marina*).

In concert with other CoBOP researchers, assess how the microbial community affects the flux of photons to and from the sediments and seagrass blades and how temporal changes in the microbiological community influence temporal changes in benthic optical characteristics.

APPROACH

I participated in CoBOP's field campaign at Lee Stocking Island (LSI), Bahamas in May and June of 1998. My objectives of this first "all-hands" expedition were first, to establish study sites, second, to collect sediment and seagrass samples for microbial lipid measurements and scanning electron microscopy (seagrass only), and third, to define and begin collaborations with other members of the CoBOP group.

In addition, I have participated in three sampling trips to Monterey Bay, California, in November 1997, April 1998, and October 1998. The objectives in Monterey Bay are similar to those at Lee Stocking Island, albeit on a smaller geographic scale. It is possible, however, to collect samples more frequently in Monterey Bay than at LSI.

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE **1998**	2. REPORT TYPE	3. DATES COVERED **00-00-1998 to 00-00-1998**

4. TITLE AND SUBTITLE **Influence of Sedimentary and Seagrass Microbial Communities on Shallow Water Benthic Optical Properties**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Old Dominion University,Department of Ocean, Earth and Atmospheric Sciences,Norfolk,VA,23529**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM002252.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**5**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

As anticipated in the previous annual report, former Ph.D. student, now Dr. Lisa Drake, has remained involved with the project and is now performing analyses of microbial lipids and is in charge of scanning electron microscope studies of seagrass epiphytes (organisms attached to plants).

WORK COMPLETED

Working in concert with the "Sediment Group", for which I act as coordinator, I sampled a variety of sediment habitats to characterize their microbial lipid signatures. The areas sampled included: Twin Beaches, Ooid Shoals, Norman's Grapestone (the area west of Norman's Pond Cay), North Perry Reef, and Channel Marker. The group designated at least two, sometimes three, so-called "sediment archetypes" at all sites and collected replicate samples of each archetype. All lipid samples (except those from Channel Marker) were extracted on LSI; microbial biomass data are presented below. A more complete analysis of the samples' fatty-acid signatures is underway.

In addition to sampling and analysis of samples from LSI, more than 30 sediment samples and 40 seagrass samples have been collected from Monterey Bay. We have focused on three areas--within an eel grass patch, diatom patches, and "bare" sand.

RESULTS

There are two fundamental elements to the types of lipid analyses I am performing. The first yields a microbial biomass value (Dobbs and Findlay, 1993). A second, more involved process, yields a profile of the microbial community based on its fatty-acid signatures (Findlay and Dobbs, 1993). Sedimentary microbial biomass at LSI study sites varies 25-fold (Table 1), a range well-suited for subsequent optical characterization and experimentation (Dobbs, 1999). Analysis of the community profiles is ongoing. Microbial lipid samples from Monterey Bay have received second-tier priority relative to those from LSI. They Monterey samples now are being extracted for analysis.

Lipid analysis of epiphytes on seagrass leaves has yielded biomass data indicating that for *Thalassia* at LSI, epiphyte biomass increases as a power function of leaf age (Table 2). These data, collected in conjunction with scanning electron microscopy of leaf surfaces, are being used in a collaboration with Dr. Richard Zimmerman (see "Impact/Application" and "Related Projects" below).

IMPACT/APPLICATION

Strictly in terms of sedimentary microbial lipids, there have been very few studies in the tropics, and none over a time course. Thus, the present opportunity to ascertain interannual temporal differences in microbial communities at a tropical site is a "first" for sedimentary microbial ecology. In the context of CoBOP, of course, the purview is much greater, given the links to multiple studies of sediment and optical parameters.

Of even more interest perhaps is the collaboration with Zimmerman, with whom we are coordinating a biochemical, microscopic, and optical characterization of epiphytes on the leaves of sea grasses found at LSI and in Monterey Bay. The epiphyte data will supplement the photophysiological information obtained by Zimmerman in his development of a canopy production model for sea grasses.

TRANSITIONS

See collaborations with other CoBOP researchers listed in "Related Projects".

****

Table 1. Microbial biomass of surface sediments (0-1 cm) at the study sites. Note there are two or three archetypes per study site. Values are expressed as micrograms of carbon per gram of sediment (dry weight); n=4 for all determinations.

SITE (ARCHETYPE)	MEAN	ST.DEV.
Norman's Grapestone (yellow)	2552	1213
Twin Beaches (film)	740	220
Norman's Grapestone (white)	577	248
Rainbow Garden (grass)	528	94
Twin Beaches (detritus)	464	116
Rainbow Garden (sand)	425	158
Twin Beaches (mounds)	346	115
Perry North (film)	292	70
Twin Beaches (non-vegetated)	245	221
Perry North (sand)	173	61
Ooid Shoals (crests)	114	27
Ooid Shoals (troughs)	105	21

****

****

Table 2. Microbial biomass of epiphytes on turtle grass (*Thalassia*) collected at the Channel Marker site at LSI. Leaf number increases with increasing age of the leaf. Biomass is expressed as micrograms of carbon per square cm of leaf surface and represent pooled samples, i.e., for each leaf number, one leaf was collected from ten plants.

LEAF NUMBER	BIOMASS
1	1.96
2	2.44
3	10.22
4	43.48

****

RELATED PROJECTS

Reports of the other members of the CoBOP Sediment Group (Allison, Brand, Burdige, Decho, Reid, Wheatcroft) may be found elsewhere in this document. We have successfully coordinated our sampling to provide a multi-parameter examination of the sedimentary environment at all sites.

In addition to interactions within the Sediment Group, there were collaborations with other CoBOP researchers:

1) For most of the sediment study sites, Ken Voss and Charlie Mazel used their instruments to measure bidirectional reflectance (BRDF) and spectral reflectance, respectively, of the sediment archetypes.

2) I assisted Paul Falkowski and Max Gorbunov in obtaining a series of laboratory measurements, using their Fast Repetition Rate Fluorometer, of cores collected from the study sites.

3) The Sediment Group assisted Mike Strand in an experiment conducted with the Fluorescence Imaging Laser Line Scanner (FILLS) at North Perry Reef. Samples of vastly different sediment from our study sites, as well as some quartz sand, were placed in containers at approximately 18 m depth. A FILLS fly-over indicated the degree to which each of these sediment types fluoresced red (685 nm), yellow (575 nm), and green (515 nm). This simple demonstration may set the stage for more elaborate experiments in future field expeditions.

4) Post-doctoral researcher Lisa Drake and I are coordinating with Richard Zimmerman in establishing cause and effect relationships between seagrass epiphytes and temporal changes in seagrass leaf IOPs and photosynthetic function (Drake et al., 1999).

REFERENCES

Dobbs, F.C. 1999. Sedimentary microbial biomass and community profiles of shallow-water carbonate environments. Abstract to be submitted to the Benthic Ecology Meeting, Baton Rouge, Louisiana.

Dobbs, F.C., and R.H. Findlay. 1993. Analysis of microbial lipids to determine biomass and detect the response of sedimentary microorganisms to disturbance. Chapter 40 in Handbook of Methods in Aquatic Microbial Ecology. (P.F. Kemp, B.F. Sherr, E.B. Sherr, and J.J. Cole, editors), pp. 347-358. Lewis Publishers, Boca Raton.

Drake, L.A., M.E. Cummings, R. Zimmerman, and F.C. Dobbs. Epiphyte load on seagrass leaves: Effects of leaf age and influence on inherent optical properties. Abstract submitted to the Aquatic Sciences Meeting, American Society of Limnology and Oceanography, Santa Fe, New Mexico.

Findlay, R.H., and F.C. Dobbs. 1993. Quantitative description of microbial communities using lipid analysis. Chapter 32 in Handbook of Methods in Aquatic Microbial Ecology. (P.F. Kemp et al., editors), pp. 347-358. Lewis Publishers, Boca Raton.

Web Addresses:

ONR's project web site:
**** http:/www.onr.navy.mil:80/sci_tech/ocean/info/clevel1/Cobop.htm

Project leader's website (Dr. Charles Mazel):
**** http://www.psicorp.com/mazel/research/cobop/cobop.html